AGENDA OF THE CEMA ENGINEERING CONFERENCE
BULK CONVEYOR ACCESSORIES COMMITTEE MEETING
Tuesday, June 27, 2017 – 1:00 PM

1. Call to order

2. Update status of Committee Chair & Vice Chair

3. Attendance and introductions – recognize new attendees

4. Review and Approval of Previous Minutes (attached)

5. Old Business
   a. Review Best Practices Document from Skirtboard Sealing Sub-Committee (Attached)
      i. Have we incorporated information brought to EC 2016?
      ii. Are there sufficient graphics?
      iii. Metric units included where applicable?
   b. Belt Tracking & Training best practices discussion
      i. Belt Book has placement guidelines and type descriptions
      ii. Ideas for best practices document
         1. Define performance & measurement technique
         2. Create load or capacity categories
         3. Other?
   c. CEMA Standard 575-2013 update for high speed, high tonnage belts? (Attached)

6. New Business – any new topics for Accessories Committee?

7. Nomination and Election of Vice Chair

8. Next Meeting – June 26, 2018 – La Playa Hotel, Naples, FL

9. Adjourn
MIINUTES OF THE CEMA ENGINEERING CONFERENCE
BULK HANDLING CONVEYOR ACCESSORIES MEETING
Tuesday, June 21, 2016 – 1:00 PM

1. Call to order – The meeting was called to order by Chair John Barickman at 1:00 P.M.

2. The Agenda was Approved

3. The minutes from 2015 Engineering Conference (attached) were approved

4. Old Business
   i) Discussed Skirtboard Sealing Best Practices. Reviewed work and data gathered to date.
      (1) Discussed 2/3 belt width. Most folks used this criteria however, sometimes 2/3 isn’t
          enough for belts <36” and too much for belts > 72”. Double check book for 5% criteria.
      (2) Discuss 2 ft for every 100 ft/min. Suggested to make sure you start after load zone.
   ii) Suggest survey minimum skirt board height. Need to canvas OEMS
   iii) Other considerations. Would like to understand better how the following applications are
        handled: multiple load points, moving hoppers, trippers, sealing pressure, tolerance
        installation, sealing catenary idlers.
   iv) Important to consider both hardness and tensile strength when selecting an elastomer for
       sealing.
   v) Additional content: Best practices in sealing catenary Idlers
   vi) Reviewed illustrations
   vii) Subcommittee expanded to include OEM’s new members include
        (1) Todd Hollingsworth
        (2) Matt Koca
   viii) Plan teleconference prior fall meeting

5. New Business
a. Brainstormed new topics for Accessories Committee
   
   i. Belt tracking and training best practices
      1. How many trackers require?
      2. How far apart?
      3. Where do you place them?
   
   ii. Need guidance on dealing with impact in load zone on high speed high tonnage belts. Not a lot of guidance on impact energy.
   
   iii. Chord. Belt wear, rip monitoring. Possibly more discussion on this in emerging technologies committee.
   
   b. Discussed whether a best practices document is required or should we compile information for next belt book. Decision was to create usable documents that could be incorporated into next belt book as applicable.
   
   c. It’s ok to start working on improving existing chapters to 7th edition.
      
      i. Judd Rosebury volunteered to start work on accessories chapter.
      
      ii. Todd Swinderman volunteered to provide some guidance on pulley diameter requirements when fitting multiple cleaners
   
6. Next Accessories meeting June 27th, 2017

7. Meeting adjourned

Greg Westphall, Vice Chair
<table>
<thead>
<tr>
<th>Name</th>
<th>First Meeting</th>
<th>COMPANY</th>
<th>Belt Cleaner Mfg.</th>
<th>e-mail</th>
<th>Tel</th>
<th>Check Attendance</th>
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</thead>
<tbody>
<tr>
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- **Mark Wilbur**: OCC
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**Signature:**

- MARK WILBUR
  - OCC
MINUTES OF THE CEMA ENGINEERING CONFERENCE
BULK BELT CONVEYOR ACCESSORIES COMMITTEE MEETING
Tuesday, June 23, 2015 – 1:00 PM

1. The meeting was called to order at 1:00 PM by Judd Roseberry. Roll call and contact info is at the end of these minutes.

2. Reviewed and approved minutes from June 24, 2014. The 2015 agenda was presented and approved.

3. Old Business

   Skirtboard sealing- Compile a list of suggested items from skirtboard manufacturing companies for proposed best practices document.

4. New Business- None to report

5. Committee Elections: Chair- John Barickman (Martin Engineering)

   Vice Chair- Greg Westphall (Flexco)


7. Meeting adjourned at 1:24 PM
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<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Initial Attendance</th>
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<tbody>
<tr>
<td>Benjamin Brewer</td>
<td>Douglas Manufacturing Co., Inc.</td>
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<td>Benjamin Robbets</td>
<td>Tenova TAKRAF, USA</td>
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<td>Jim Myers &amp; Sons Inc.</td>
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<td>Darrel Taylor</td>
<td>Kinder Morgan Engineering &amp; Converying</td>
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<td>Donald Budeman</td>
<td>Bunting Hydraulics</td>
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<td>Dr. Andrew Stankiewicz</td>
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<td>Dr. Robin Sorenzini</td>
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<td>Superior Industries</td>
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<td>Jeff Manish</td>
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<td>Jeremy Watts</td>
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<td>Jim Nasek</td>
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<td>John Raymond</td>
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<td>Judd Rosamuro</td>
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<td>Kenari Mina</td>
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<td>Richard McConnell</td>
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<td>Terry Olson</td>
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<td>Tim Wolf</td>
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<td>Eric Jackson</td>
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THE VOICE OF CONVEYOR INDUSTRY OF THE AMERICAS
The primary purpose of a skirtboard is to keep the load on the conveyor, preventing material spillage over the belt edge, while the load is settling onto the belt and material has reached belt speed. Best practices in chute and skirtboard design now provide the opportunity for much cleaner and more efficient material handling system.

The skirtboard and the wear liner placed inside the skirtboard combine with an elastomer sealing system to form a multiple-layer seal. The elastomer seal should not be expected to withstand material side pressures or pieces of material larger than small fines. The skirtboard and wearliner form the first line of defense intended to contain fugitive material and prevent material head pressure from contacting the sealing system. To avoid entrapment of material between skirtboards, wear liner, and belt, skirtboards should be installed so they taper upwards providing increased clearance from the belt (vertical).

Inadequately sized skirtboard always leads to poor conveyor performance in form of material spillage, excessive dust, and higher operating cost by the end user.

**Proper Skirtboard Size:**

**Length** - Refers to additional length of steel beyond the impact zone. Skirtboard should extend past point where material fully settles onto the profile. The length needed for the bulk material to reach receiving belt speed and settle into the surcharge profile is calculated in the equation below (Eq. 12.45 p.513 Belt Book).

\[
L_a = \frac{V_b^2 - V_{ey}^2}{2g (\mu_b - \tan(\theta))}
\]

- \(L_a\) = distance to accelerate bulk material to receiving belt speed
- \(V_b\) = velocity of receiving belt
- \(V_{ey}\) = vertical velocity of bulk material as it leaves discharge chute
- \(g\) = gravitational constant
- \(\mu_b\) = effective coefficient of friction between bulk solids, skirtboards and belt
- \(\theta\) = inclination angle of receiving belt
If difference between \( V_b \) and \( V_{ey} \) is small and receiving belt flat, \( L_a = 2 \) ft. per 100 ft./min belt speed, with minimum 3 feet past loading chute

It is good practice to terminate skirtboards above an idler rather than between idlers to prevent spillage or belt damage.

**Width**- CEMA recommends distance between skirtboards is \( 2/3 \) width of troughed belt. May be more effective to recommend amount of free belt edge distance \textbf{minimum} required for belt edge seal and belt wander; acceptable amount of belt wander is 1.00” (25mm).

**Height**- Contributing factors effecting height of skirtboard include belt width and speed, material lumps and air speed at discharge. Skirtboard should be tall enough to contain the material load when belt is operating at normal capacity and to pass two of largest lumps stacked on top of each other without jamming. CEMA has published a table specifying minimum height for uncovered skirtboards (Table 12.47 p.515 Belt Book). For dusty materials, it is a good practice to increase height of skirted area to create an added space to reduce positive air pressure. This area serves to “still” dust laden air so particles can fall back onto the cargo of the conveyor. To control dust, the cross sectional area of the chute should be sized to keep the exit air velocity below 200-250 feet/minute. If this maximum exit velocity cannot be achieved, then mechanical dust suppression or collection is necessary.

**Purpose of Wear Liner**

A. Provides sacrificial, easily replaceable wear surface protecting wall of the chute and skirtboard
B. Helps center the material load
C. Prevents material load from applying high side forces to sealing strips
D. Can reduce friction, impact, noise, and degradation of bulk material

**Wear Liners-4 styles: straight, spaced, deflector, tapered**

**Straight Wear Liner**- Real benefit is it provides improved life and improved sealing effectiveness without closing down the effective load area. Best for belts with multiple load points.

**Spaced Wear Liner**- Variation of straight where a space is created between the skirtboard and liner used as a negative pressure area. Fines and dust can be pulled from this space by a dust collection system.

**Deflector Wear Liner**- Bend inward at bottom half of liner- provides free area between elastomer seal and liner for collecting fines for the outer seal to handle without the outward forces of material load. Reduces effective cross-sectional area of the skirtboard area.

**Tapered Wear Liner**- Cast from Molybdenum steel for use in heavy duty applications. The cross section is trapezoidal to reduce the gap where the bottom edge meets the belt, skirtboard, and
skirting seal. They are heavy and supplied in short lengths, therefore difficult to keep bottom edges in a smooth straight line.

**Edge Sealing Systems**

Effective sealing at the edge of a belt requires a properly supported belt, wear liners, skirtboards, and an edge seal. A number of engineered sealing systems are now commercially available. These systems consist of a strip of elastomer attached to the lower portion of the skirtboard by an arrangement of clamps. Effective sealing requires an adequate amount of free belt distance. Free belt distance, amount of belt outside the skirtboard on both sides of the conveyor, provides space for the sealing system and belt wander. A good practice is to use a minimum of 3.50” (90mm) for the sealing system and 1.00” (25mm) for belt wander. The seal should start in the loading area and continue to the end of the settling zone.

There are a number of different approaches to skirtboard sealing. The best way to define these systems is to describe where each contacts the belt.

**Vertical Sealing**- This type of sealing arrangement uses a single rubber or elastomer sealing strip attached to the skirtboard with some type of clamp.

**Advantages:**
1. Low in cost
2. Minimal free belt edge required
3. Can be self-adjusting

**Disadvantages:**
1. Difficult to adjust accurately
2. Easily over adjusted causing premature wear
3. Prone to material entrapment
4. Susceptible to leakage of dust and fines

**Inward Sealing**- This type of seal contains an elastomer seal clamped to the outside of the skirtboard with the lower portion curled back under the steel.

**Advantages:**
1. Self-adjusting
2. Require limited free belt edge distance
3. Handle light fluffy and fine non-abrasive materials
4. Handle high internal chute pressure
5. Handle severely mistracking belts

**Disadvantages:**
1. Shorter seal life due to being in material flow
2. Prone to material entrapment under sealing strip-leads to premature belt wear
3. Reduced carrying capacity due to space taken up by the seal where the load could be carried

**Outward Sealing** - Type of system that seals on the outside of skirtboard. The most effective is a multi-layered seal containing a primary strip which contains most of the material escaping past wear liner and secondary seal containing fines and dust.

**Advantages:**
1. Long lasting- positioned away from material flow and protected by skirtboard and wear liner
2. Can be self-adjusting
3. Low required sealing pressure due to multiple layered sealing design
4. Adapt to existing clamp system

**Disadvantages:**
1. Require greater free belt edge distance
2. Susceptible to damage if belt mistracks underneath seal

The skirtboard seal should not be the first line of defense in preventing material spillage, but rather a last chance to contain fugitive material and prevent its release. The better job done by the belt support and wear liner systems to contain material and keep it away from the belt edge, the better the performance will be of the belt’s edge sealing system. A multi-layer flexible seal incorporating some self-adjustment will provide effective material containment for a transfer point. Maintenance and periodic inspection are also important to extend the life of the conveyor’s sealing system.
CEMA Skirtboard Sealing
FLEXCO Commentary
June 10, 2016

WIDTH

- In favor of maintaining the 2/3rd belt width specification. Concern was that changing standard to reference an offset from the edge of the belt would restrict the throat of the chute too severely for material flow on the narrower belt sizes (≤36”).
- Would consider a rule stating skirt width is 2/3rd belt width or 12” of freeboard from edge of belt, whichever results in a larger chute opening.

BELT WANDER

- While 1” maximum of belt wander is a laudable goal, we feel that it does not represent general practice. Standard return idler widths assume approximately 1-1/2” of belt wander before the belt runs off the end of the idler, and frequently belts are even beyond this point.
- Transfer points should be designed conservatively so that spillage is not occurring under typically conditions. To that end, we suggest that skirting be designed to accommodate belt mistracking of 2” or 5% of belt width, whichever is greater, without spillage.

SKIRTING TYPES

- Inward – We refer to this as tangential skirt. Are there names/descriptions for this design?
  - Excellent seal against dust
  - Dips and moves as the belt traverses idlers (Slider beds not needed)
  - Slow wearing
  - Choose durometer to be softer than belt (60A typically)
  - Excessive belt wander will disengage this skirting rendering it inoperable.
  - Lack of freeboard prevents use on belts ≤36”
- Vertical
  - “Standard” skirting predominate in the industry
  - Requires least amount of freeboard
  - Can be fixed position or self-adjusting
  - Usually suffers from uneven wear against belt rendering it less effective at containing dust and material
  - Frequently wears a shallow groove in the top cover of belt
• Outward
  o Include multiple seal skirting designs in the category?
  o Requires more freeboard than vertical skirting

WEAR LINER
• Clearly define and distinguish “skirt wall”, “skirt board”, “wear liner”, “canoe liner”, etc.
• Types & materials
• Intended to contain material (lumps), not dust?
• Application guidelines

BELT TRANSITION
• Do not load belts in the transition zone
• Effective skirting systems are very difficult to design in this zone. Subpar material containment is likely

MINIMUM HEIGHT
• If a minimum chute opening of 2/3rd belt width is maintained, we favor a minimum 8” tall wear liner and a minimum 15” skirt wall for covered skirting systems.

PERPENDICULAR SKIRTING
• The chute wall is bent outward to make 90° intersection with the troughed belt surface.
• Flat skirt rubber is used. (Not tangential or outboard)
• When multiple chutes load onto the same belt, the downstream chutes need perpendicular skirting
• The inlet is usually AR steel and flared
• This skirting is less likely to disturb already loaded material

SKIRT MATERIAL DUROMETER & ABRasion INDEX
• Conventional wisdom says the skirt material should be of a softer durometer than the belt
• We typically use 60A rubber
• Do not know what the abrasion index is or have experience with higher durometer skirt materials

SKIRT PRESSURE
• We do not have a specification or target value for skirt pressure
DIN & ISO

- I was unable to locate any DIN or ISO standards regarding conveyor skirting.
SIX STEP METHODOLOGY FOR MATERIAL CONTAINMENT ON A CONVEYOR BELT

I. Achieve constant and consistent belt elevation
   A. Full idler / belt contact both empty and full loading conditions
   B. Full trough transition
   C. Belt fully troughed to final conveyor trough angle
   D. Avoid catenary curves near the load zone

II. Provide impact protection
   A. Absorb impact
   B. Protect belt
   C. Reduce material bounce

III. Provide proper belt support
   A. Continuous bed under seal area
   B. Belt support stands between idlers at seal location prevent belt sag between components which allow gaps

IV. Containment of bulk material
   A. Proper size skirt board
      1. Length (0.02 X Belt speed or equation?)
      2. Width: Free edge distance may be problematic for walking conveyors, narrow conveyors (outward seal design may limit loading width), or different types of skirt manufacturers while 2/3 BW may be problematic for narrow conveyors (may not have enough room for sealing components)
      3. Height

V. Wear liners
   A. Straight
   B. Spaced
   C. Deflector
   D. Tapered

VI. Sealing of dust and fines
   A. Edge sealing (I believe we should remove the advantages/disadvantages portion as different manufacturers may develop components to mitigate disadvantages)
      1. Vertical
      2. Inward
      3. Outward
      4. Skirt liners (similar to wear liners but on outside of skirt boards)
   B. Covered conveyor sections
   C. Stilling chambers
   D. Dust curtains
   E. Vacuum systems
WARNING

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

INSTRUCTIONS

1. Loosen Canoe Liner Hardware.
2. Lift Canoe Liner.
3. Insert Liner Gauge Between Canoe Liner and Belt while bridging Saddles or Idlers with gauge.
4. Fully lower Canoe Liner onto Liner Gauge to set gap.
5. Tighten Canoe Liner Hardware.
6. Remove and reposition Liner Gauge for next Canoe Liner section.
WARNING

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

INSTRUCTIONS

1. Loosen Canoe Liner Hardware.
2. Lift Canoe Liner.
3. Insert Liner Gauge Between Canoe Liner and Belt while bridging OEM Idlers with gauge.
4. Fully lower Canoe Liner onto Liner Gauge to set gap.
5. Tighten Canoe Liner Hardware.
6. Remove and reposition Liner Gauge for next Canoe Liner section.

Canoe Liner

Liner Gauge / Set Up Tool
Dwg#: B-12048
Inv#: GAB-12048

DETAIL B
SCALE 1 : 4

Canoe Liner Hardware

Belt
WARNING
Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

INSTRUCTIONS
1. Loosen Canoe Liner/Skirt Liner Hardware.
2. Lift Canoe Liner and Skirt Liner.
3. Insert Liner Gauge Between Canoe Liner/Skirt Liner and Belt while bridging Saddles or Idlers with gauge.
4. Fully lower Canoe Liner/Skirt Liner onto Liner Gauge to set gap.
5. Tighten Canoe Liner/Skirt Liner Hardware.
6. Remove and reposition Liner Gauge for next Canoe Liner/Skirt Liner section.
**WARNING**

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

**INSTRUCTIONS**

1. Loosen Canoe Liner/Skirt Liner Hardware.
2. Lift Canoe Liner and Skirt Liner.
3. Insert Liner Gauge Between Canoe Liner/Skirt Liner and Belt while bridging OEM Idlers with gauge.
4. Fully lower Canoe Liner/Skirt Liner onto Liner Gauge to set gap.
5. Tighten Canoe Liner/Skirt Liner Hardware.
6. Remove and reposition Liner Gauge for next Canoe Liner/Skirt Liner section.

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**Linex Gauge Instructions ~ Canoe Liner, Skirt Liner over OEM Idlers**
**DETAIL E**
**SCALE 1 : 4**

**WARNING**
Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

**INSTRUCTIONS**
1. Loosen Canoe Liner Hardware.
2. Release Skirt Clamp.
3. Lift Canoe Liner and Skirt Rubber.
4. Insert Liner Gauge Between Canoe Liner/Skirt Rubber and Belt while bridging Saddles or Idlers with gauge.
5. Fully lower Canoe Liner/Skirt Rubber onto Liner Gauge to set gap.
6. Tighten Canoe Liner Hardware.
7. Engage Skirt Clamp.
8. Remove and reposition Liner Gauge for next Canoe Liner/Skirt Rubber section.
**WARNING**

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

**INSTRUCTIONS**

1. Loosen Canoe Liner Hardware.
2. Release Skirt Clamp.
3. Lift Canoe Liner and Skirt Rubber.
4. Insert Liner Gauge Between Canoe Liner/Skirt Rubber and Belt while bridging OEM idlers with gauge.
5. Fully lower Canoe Liner/Skirt Rubber onto Liner Gauge to set gap.
6. Tighten Canoe Liner Hardware.
7. Engage Skirt Clamp.
8. Remove and reposition Liner Gauge for next Canoe Liner/Skirt Rubber section.

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WARNING

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

INSTRUCTIONS

1. Release Skirt Clamp.
2. Lift Skirt Rubber
3. Insert Liner Gauge Between Skirt Rubber and Belt while bridging Saddles or Idlers with gauge.
4. Fully lower Skirt Rubber onto Liner Gauge to set gap.
5. Engage Skirt Clamp.
6. Remove and reposition Liner Gauge for next Skirt Rubber section.
WARNING

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

INSTRUCTIONS

1. Loosen Skirt Liner Hardware.
2. Lift Skirt Liner
3. Insert Liner Gauge Between Skirt Liner and Belt while bridging Saddles or Idlers with gauge.
4. Fully lower Skirt Liner onto Liner Gauge to set gap.
5. Tighten Skirt Liner Hardware.
6. Remove and reposition Liner Gauge for next Skirt Liner section.
**WARNING**

Before installing or servicing equipment, turn off and lock out/tag out energy source to conveyor and conveyor accessories.

**INSTRUCTIONS**

1. Loosen Skirt Liner Hardware.
2. Lift Skirt Liner.
3. Insert Liner Gauge Between Skirt Liner and Belt while bridging OEM Idlers with gauge.
4. Fully lower Skirt Liner onto Liner Gauge to set gap.
5. Tighten Skirt Liner Hardware.
6. Remove and reposition Liner Gauge for next Skirt Liner section.

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VERTICALLY SEALING SKIRT SOLUTION

INSTALL THE SKIRT LINERS TO 1/2" AWAY FROM THE CONVEYOR BELT THEN ADJUST SKIRT LINERS IN THE LINER'S SLOT TO 1/8" AWAY FROM THE CONVEYOR BELT.

TANGENTIALLY SEALING SKIRT SOLUTION

INSTALL THE SKIRT LINERS TO 1/2" AWAY FROM THE CONVEYOR BELT THEN ADJUST SKIRT LINERS IN THE LINER'S SLOT TO 1/8" AWAY FROM THE CONVEYOR BELT.

CEMA Skirt Width

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CEMA STANDARD NO. 575-2013

Bulk Material Belt Conveyor
Impact Bed/Cradle

Selection and Dimensions

CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

5672 Strand Court, Suite 2
Naples, Florida 34110
Phone: (239) 514-3441
www.cemanet.org

Revision of CEMA Standard 575-2000
Approved: September 10, 2013

CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION (CEMA)

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END
List of Changes and Explanations

1. Pg. 1 – Definitions: Changed N (length of impact zone) to L_n to maintain consistency with the belt book.

2. Pg. 1, 8 – Definitions: Changed T_e(IB) to ΔT_{IB}, T_{em}(IB) to ΔT_{IB} to maintain consistency with universal method in belt book.

3. Pg. 1, 8 – Changed f (coefficient if friction value – dimensionless) to C_b to maintain consistency with the belt book.

4. Pg. 1, 8 – Removed T_e(TI), T_{em}(TI) from power loss calculations. Calculating the effects of the small amount of idlers removed and replaced with impact beds can be very time consuming under the universal method as detailed in belt book. Equations for ΔT_{isn} (change in tension from idler seal friction), ΔT_{iw} ( Change in tension from idler load friction), ΔT_{imn} (tension loss from idler misalignment), and ΔT_{mzn} (tension change due to bulk material moving between idlers) would need to be added. Removing the tension effects of the small amount of idlers results in a power loss calculation typically 10% to 15% higher than when the idlers are accounted for. This difference errs on the side of caution and greatly simplifies the calculations.

5. Pg. 8 – Changed table 2 to match belt book (table 6.67) coefficient of friction values for various materials.

6. Pg. 1, 8 – Added R_b (friction modifying factor) to power loss calculation to maintain consistency with the belt book.

7. Adjusted calculations to maintain 2 significant digits.

8. Updated table of contents.
Foreword

Impact Beds/Cradles are used to reduce premature idler failure and reduce belt damage in the load zone of bulk material handling conveyor systems. This standard has been established to provide a uniform method of rating and dimensioning among the various manufacturers of conveyor belt Impact Beds/Cradles.

This standard assures the users of conveyor Impact Beds/Cradles that an Impact Bed/Cradle is dimensionally compatible with conveyor idlers manufactured to the CEMA Standard No. 502, most current revision. The 575 standard establishes impact energy ratings to assure the end user the Impact Bed/Cradle is structurally suitable for the application. This standard does not restrict the manufacturer, who has complete freedom to design all parts of the Impact Bed/Cradle according to its best engineering judgment based upon the information supplied by the end-user.

There are three classes of Impact Beds/Cradles rated according to the weight and height of fall of the bulk material and conveyor idler class. Manufacturers voluntarily specify into which class their particular designs fall.

It is hoped this standard will assist the end user in receiving an Impact Bed/Cradle, which is structurally suitable for the specified conditions and reduce the misapplication of Impact Beds/Cradles.

The capacity of the conveyor belt to withstand impact varies according to belt construction. Contact the belt supplier for information regarding the ability of a specific conveyor belt to withstand impact.

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Definitions

**A**: Base width mounting holes center to center distance.

**B**: Mounting foot mounting holes center to center distance.

**C**: Overall width of the Bed/Cradle.

**C_b**: Coefficient of friction impact bed, dimensionless

**D**: Overall length of the mounting foot.

**E**: Maximum height of the outer edge of the Bed/Cradle.

**H**: Maximum distance from outer edge to outer edge of the Bed/Cradle sliding surface.

**h**: Vertical fall distance of a lump from the center of gravity of the homogeneous load or lump to the belt in feet.

**h_m**: Vertical fall distance of a lump from the center of gravity of the homogeneous load or lump to the belt in meters.

**K**: Maximum height of the center roller of the inbound/outbound idler, or distance to the bottom of the belt.

**k**: The spring constant of the entire Impact Bed/Cradle including the sliding surface and support structure in lbs per inch.

**k_m**: The spring constant of the entire Impact Bed/Cradle including the sliding surface and support structure in newtons per meter [N/m].

**L**: Mounting bolt diameter.

**L_n**: Length of the impact zone in ft.

**L_nm**: Length of the impact zone in meters.

**M**: Clearance between the belt and the center sliding surface.

**R_b**: Coefficient of friction modifying factor.

**ΔT_IB**: Change in belt tension as a result of impact bed in lbs.

**ΔT_IBm**: Change in belt tension as a result of impact bed in N.

**V**: Belt speed in feet per minute.

**V_m**: Belt speed in meters per second.

**Q**: Flow rate of the bulk solid in short tons per hour.
Q_m: Flow rate of the bulk solid in metric tons (tonnes) per hour.

W: Mass of single lump in pounds.

W_n: Mass of single lump in kilograms.

W_b: Weight of belt in lbs per foot of belt length.

W bm: Weight of belt in newtons per meter of belt length.

W_m: Weight of material in lbs per foot of belt length.

W mm: Weight of material in newtons per meter of belt length.

W_e: Equivalent mass of flowing bulk material in lbm.

W em: Equivalent mass of flowing bulk material in kg.

Impact Bed: A conveyor component that is located underneath the belt in the impact or loading zone of a bulk material handling conveyor belt transfer point designed to support the belt and help absorb the impact of falling material.


Outbound Idler: The idler immediately after the Impact Bed/Cradle in the direction of belt travel.

Inbound Idler: The idler immediately preceding the Impact Bed/Cradle in the direction of belt travel.

Transition Distance: The distance between where the belt leaves a terminal pulley of a belt conveyor and the point where the belt is fully troughed.

Transition Idler: An idler with metal rollers and adjustable wing angles to help support the belt in the transition from a terminal pulley to a troughed configuration.

Slider Bed: A support under the carrying side of a conveyor belt that is designed to handle the sliding load of the belt and the bulk solid.

Loading Zone: The area where material is received on the conveyor belt.
Rating and Class System

Impact Beds/Cradles are rated according to their structural capacity to absorb the force of impact from a falling lump or stream of bulk solid. There are three simplified ratings based upon the weight of the bulk solid or equivalent mass of homogeneous stream multiplied by the height of the fall (W × h).

The impact energy from a falling single lump is significantly more than that from a homogeneous stream of bulk material so in most applications the weight of the largest lump that can be expected is the critical variable. Table 1 gives the impact energy rating ranges for Impact Beds/Cradles. Contact a CEMA member for impact energies over 2000 ft-lb, as the impact may exceed the impact ratings of most fabric ply belts.

<table>
<thead>
<tr>
<th>Table 1 – Impact Bed/Cradle Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Energy lb-ft (N-m)</td>
</tr>
<tr>
<td>L - Light Duty &lt;200 (271)</td>
</tr>
<tr>
<td>M - Medium Duty 200 to 1,000 (271 to 1,356)</td>
</tr>
<tr>
<td>H - Heavy Duty 1,000 to 2,000 (1,356 to 2710)</td>
</tr>
<tr>
<td>Consult CEMA Member &gt; 2,000 lb-ft or 2,710 N-m</td>
</tr>
</tbody>
</table>

The designation for an Impact Bed/Cradle shall be the duty rating followed by the Idler class. For example a Heavy Duty Impact Bed/Cradle which is dimensionally compatible with CEMA D6 idlers in the load zone shall be designated as H-D6.

<table>
<thead>
<tr>
<th>H</th>
<th>D6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty Impact Rating</td>
<td>CEMA Idler Class D6 for Dimensions</td>
</tr>
</tbody>
</table>

Impact Bed/Cradle Dimensional Standard

The CEMA Idler Class for the idlers used in the load zone shall determine the dimensional class of the Impact Bed/Cradle. The dimensions A through K corresponds to the dimensions in the CEMA Standard for Bulk Material Belt Conveyor Troughing and Return Idlers No. 502, most current revision (see figure 1).

Location of Impact Beds/Cradles

Impact Beds/Cradles are placed in load zone in the area of direct impact from the falling lumps or stream of material. The Impact Bed/Cradle should be positioned so the impact is striking the impact bars or pads at the center. The belt must be fully transitioned with properly fitted metal transition idlers before the entry into the Impact Bed/Cradle. A suitable idler which is dimensionally compatible may be used as the inbound idler just preceding the first Impact Bed/Cradle. When the impact area is long or there are multiple load points, intermediate idlers which are dimensionally compatible may be used to separate Impact Bed/Cradle sections (see figure 2).
The belt must be fully troughed according to CEMA “Belt Conveyors for Bulk Materials” and the transition idlers must be constructed with metal rollers. A suitable idler which is dimensionally compatible may be used as the outbound idler just following the last Impact Bed/Cradle.

**Impact Bed/Cradle Selection**

1) **Determine the dimensional class**

The dimensional class of the Impact Bed/Cradle is the same as the CEMA class of the idlers in the load zone. All of the idlers in the load zone must be from the same manufacturer, have the same trough angle, be of the same CEMA class and be in good working condition or the Impact Bed/Cradle will not fit or function properly. Contact a CEMA member if your load zone is not fitted with idlers all from the same manufacturer, of the same trough angle or all of the same CEMA class. Example: The idlers in the impact zone are CEMA D6. The dimensional class of the Impact Bed/Cradle is therefore D6.

*Note: Some manufacturers’ designs do not use standard CEMA Dimensions for L, B, or D*

![Figure 1 – Typical Impact Bed / Cradle](image-url)
Figure 2 – Transition Distance, Inbound and Outbound Idler Positions
Figure 3- Impact Bed/Cradle - Bar Type

Figure 4- Impact Bed/Cradle - Saddle Type
2) Determine the Duty Rating

The duty rating of a CEMA Impact Bed/Cradle is determined by the maximum impact energy that will be created by the falling lump or stream of material. A simplified formula of the weight of the largest lump, W, or the rate of flow, Q, of the material and the vertical height of fall, h, is used to determine the rating. Calculate both quantities and select the larger of the two values for determining the appropriate duty rating.

*For flow rates below 3000tph [2722 tonnes/hour], it is not necessary to calculate the equivalent mass of a homogeneous stream since it will be negligible.*

**Material containing large lumps**

Determine the maximum lump size that will be conveyed. Calculate the weight, W (lbs.) or Wₙ (kg), of the lump. If slabs of material are likely to pass through the system use the maximum size slab to determine the maximum lump weight. Determine the maximum vertical fall distance, h (ft) or hₘ (meters). The impact energy is given by equation #1.

\[
\text{Equation \#1 Impact Energy (lb-ft) } = W \times h \text{ (Imperial)}, \text{ (see figure 5).}
\]
\[
\text{Impact Energy (N-m) } = W_n \times h_m \text{ (SI) (see figure 5).}
\]

Consult Table 1 to determine the appropriate duty rating.

*Figure 5 - Determine impact energy from a single lump*

**Homogeneous stream of material without large lumps-(For Q>3000 st/hr, or Qₘ>2,722 t/hr)**

Determine the maximum vertical fall distance h (feet), hₘ (meters). Determine the design rate of flow, Q (short tons per hr.), Qₘ (tons/hr), of conveyed material. In order to use the lump energy equation, an equivalent mass of the flowing stream needs to be calculated.

\[
\text{Equation \#2 Equivalent Mass (Wₑ)= } 8.03 \times 10^{-4} \times Q^2 / k \text{ [imperial] (see Figure 6)}
\]
\[
\text{Equivalent Mass (Wₑₘ)= } 7.72 \times 10^{-2} \times Q_m^2 / k_m \text{ [SI] (see Figure 6)}
\]

The impact energy is given by equation #1. Add the equivalent mass to the largest lump mass multiplied by the drop height (h or hₘ) to determine the duty class from Table 1.
Power Requirements

Impact Beds/Cradles can have a significant effect on the power requirements of a conveyor, particularly for short conveyors. It is advisable to calculate the theoretical power requirements for an Impact Bed/Cradle and check the available power of the drive.

The power requirement is determined by the formulas:

**Imperial**

\[ \Delta T_{IB} = C_b \times (W_b + W_m) \times L_n \times R_b \]

Power Loss (HP) = \( \Delta T_{IB} \times V \) ÷ 33,000

**SI**

\[ \Delta T_{IBm} = C_b \times (W_{bm} + W_{mm}) \times L_{nm} \times R_b \]

Power Loss (KW) = \( \Delta T_{IBm} \times V_{m} \) ÷ 1,000

The default value for \( R_b \) is 1.00 but when starting under full load use \( R_b = 1.50 \)

<table>
<thead>
<tr>
<th>Sliding Surface</th>
<th>( C_b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>0.64 to 0.84</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>0.56</td>
</tr>
<tr>
<td>Urethane</td>
<td>0.60 to 0.67</td>
</tr>
</tbody>
</table>

**Example: Imperial**

A 60-inch conveyor traveling at 750 fpm is conveying 8 inch minus ore, which weighs 120 lb/ft³ at the rate of 2500 tph. The solid density of the ore is 180 lb/ft³. The conveyor is equipped with CEMA D6 impact rollers in the load zone. The vertical drop at the transfer point is 12 ft and the impact is confined to an area approximately 4 feet long. Determine the rating and class for an Impact Bed/Cradle for this application. Determine the horsepower requirements for the Impact Cradle.
Rating

Since the lump size is large in this application it is probably material from a primary crusher that has passed through a grizzly with 8-inch square openings. It is accepted practice to assume the largest slab that could pass through the grizzly would be 8 inch thick by 8 inch wide by 24 inch long.

To calculate the impact energy from the homogeneous stream it will be necessary to obtain a value of k from a CEMA member manufacturer. For this example use 70,000 lb/ft (5833 lb/in).

- The weight of the largest lump that could be expected to impact the receiving belt would be
  \[
  \text{Volume} = \frac{8 \times 8 \times 24}{1728} = 0.89 \text{ ft}^3.
  \]
  \[
  \text{Weight of lump} = 0.89 \text{ ft}^3 \times 180 \text{ lb/ft}^3 = 160.20 \text{ lb}.
  \]
- From figure 5 the impact energy is:
  \[
  W \times h = 160.20 \times 12 = 1922.40 \text{ lb-ft}
  \]
- Equivalent mass from a homogeneous stream of material is given by Equation 2.
  \[
  W_\text{e} = 8.03 \times 10^{-4} \times 2500^2 / k = 0.86 \text{ lb}, \text{ Impact energy} = 0.86 \text{ lb} \times 12 \text{ ft drop} = 10.32 \text{ lb-ft}.
  \]
- From Table 1 the rating for this application would be H (Heavy Duty) because the largest calculated impact energy value falls between 1,000 and 2,000 lb-ft.

Class

Since CEMA D6 idlers are used in the impact zone the dimensional class for this application is D6.

Rating and Class

The correct Impact Bed/Cradle designation for rating and class for this example is H-D6.

Power Requirements

In order to calculate the power requirements you will have to know the values of \( W_b \) and \( W_m \). These values can be obtained from the design calculations of your conveyor or from a CEMA member manufacturer. Estimates of these values can be made by referring to the latest revision of the CEMA publication “Belt Conveyors for Bulk Materials.”

For this example use the weight per foot of the belt, \( W_b \), as 22 lb/ft. The weight of material per foot of belt is 111.11 lb/ft. To estimate the dynamic power requirement use \( C_b = 0.56 \) for a UHMW cover material on the Impact Bed/Cradle.

\[
\Delta T_{IB} = C_b \times (W_m + W_b) \times L_n \times R_b
\]
\[
\Delta T_{IB} = 0.56 \times (111.11 + 22.00) \times 4 \times 1 = 298.17 \text{ lb}
\]

Power loss (HP) = \( (\Delta T_{IB} \times V) / 33,000 \)

Power loss (HP) = \( [298.17 \times 750] / 33,000 = 6.78 \text{ HP} \)
Example: SI

- Belt Size= 1500mm
- Belt Speed= 3.81 m/s
- Bulk Density= 1922 kg/m$^3$
- Solid Density= 2883 kg/m$^3$
- Bulk Material Flow rate ($Q_m$)= 2268 metric tons per hour
- Vertical Drop ($h_m$)= 3.66 m
- Largest lump slab size= 203 mm thick x 203 mm wide x 610 mm long
- Length of impact zone = 1.22 m
- Weight of belt, $W_{bm}$ = 321.05 N/m
- Weight of material, $W_{me}$ = 1621.52 N/m
- Volume of largest lump= (203 x 203 x 610)/1x10$^9$= 2.51(10)$^{-2}$ m$^3$
- The weight of the largest lump would be 2.51(10)$^{-2}$ m$^3$ x 2883 kg/m$^3$ = 72.36 kg
- Impact energy for single lump: $W_m$ x $h_m$ = 72.36 x 3.66 x 9.81 =2598.06 N-m
- Equivalent mass $W_{em}$: $0.0772 x 22682/k_m=0.39$ kg (where $k_m=1021500$ N/m)
- Impact energy for Equivalent mass= 0.39 x 3.6 x 9.81=13.8 N-m

Power Requirements: SI Calculation

$$\Delta T_{ibm} = C_b x (W_{mm} + W_{bm}) x L_b x R_b$$
$$\Delta T_{ibm} = 0.56 x [(1621.52 + 321.05) x 1.22] x 1 = 1327.16 \text{ N}$$

Power loss (kW) = ($\Delta T_{ibm} x V_m$) ÷ 1000

Power loss (kW) = (1327.16 x 3.81)/1000 = 5.06 kW

Conclusion

The proper rating and class of Impact Bed/Cradle for this example is H-D6. The running power requirement for the Impact Bed/Cradle is 6.78 HP (5.06 kW). The maximum impact energy expected to be transmitted to the conveyor structure is 1922.40 lb-ft (2598.06 N-m).

Comments

It is important to determine the maximum lump size that can be expected to pass through the transfer point as the single impact from a single lump almost always produces the greatest impact force. A round 8-inch lump in this example would weigh 27.92 lbs and create an impact energy of 335.04 lb-ft for a medium-duty rating. In this example an 8 inch × 8 inch × 24 inch slab merits a heavy-duty rating with an impact energy of 1922.40 lb-ft.

Even though 8-inch minus material does not fit the definition of a homogeneous stream of material it is good to check both impact energies. It is important to check the structure that will support the Impact Bed/Cradle to make sure it can handle the load.
Special Applications

Consult a CEMA member for applications involving explosive bulk solids or for other applications with unique requirements such as food grade construction, corrosion or chemical resistant applications, extreme temperature or belt speeds over 1,000 fpm (5 m/s).

Typical Specification: Impact Bed/Cradle

Impact Beds/Cradles shall be designed to meet CEMA Standard 575, the most current version.

The Impact Bed/Cradle shall be designed to withstand the maximum impact force as determined by the greater of the two calculations:

- Equation #1 Impact Energy = W x h (imperial), W_n x h_m [SI]
- Equation #2 Equivalent Mass (W_e) = 8.03x10^-4 x Q^2/k [imperial]
  Equivalent Mass (W_{en}) = 7.72x10^-2 x Q_m^2/k_m [SI]

The manufacturer shall use the information supplied by the end user to establish which rating and class of Impact Bed/Cradle is to be provided. The Impact Bed/Cradle shall be designed to withstand the force of a single maximum impact with a design factor of 1.5.

The manufacturer shall specify:
- Any exceptions to the standard contained in their design.
- The duty rating and class of the Impact Bed/Cradle using the CEMA rating and class system.
- Any limitations resulting from the application as specified by the end user.

The end user shall specify:
- The maximum lump or slab weight (lb-imperial, kg-SI) that will pass through the load zone.
- The maximum bulk density (lb/ft^3 [imperial], kg/m^3 [SI]) of the bulk solid being handled.
- The maximum drop height (ft, m).
- The maximum flow rate of the bulk solid (short tons/hr [imperial], tons/hr [SI]).
- The CEMA class and trough angle of the idlers in the load zone and the manufacturer’s product number designation.
- Belt speed (feet/min [imperial], meters/sec [SI]).
- Certification based on product specifications supplied by the manufacturer, that the existing structure is capable of supporting the weight of and the impact force transmitted by the Impact Bed/Cradle to the structure.
- Whether or not the bulk solid being conveyed is flammable or explosive.
- Special construction requirements for corrosion resistance or process compatibility.
- Length of load zone.

The transition idler(s) shall be a metal idler(s) and the inbound idler(s), if present, must be from the same manufacturer, have the same trough angle, be of the same CEMA class, be in good working condition, and the belt shall be fully troughed before entering the Impact Bed/Cradle and upon leaving the Impact Bed Cradle.
If more than one load zone is used intermediate idlers of the same CEMA class will be used between Impact Beds/Cradles.

Disclaimers

This standard implies no representation that a particular belt is suitable to be used in combination with a particular Impact Bed/Cradle. Contact the belt supplier for information on the impact capacity of the belt.

Each manufacturer is responsible for the design of their product including the suitability for use in applications where fire retardant Impact Beds/Cradles may be required by statute or application.

The replacement of idlers with an Impact Bed/Cradle may increase the horsepower requirements of the conveyor drive. Contact a CEMA member for information.

Impact Beds/Cradles may be required to meet additional industry or government standards or requirements such as for use in underground mines, hazardous locations or for food handling that are not spelled out in this standard. Contact a CEMA member for information.

CEMA reserves the right to revise this standard at any time without notice.

Units

<table>
<thead>
<tr>
<th>Imperial</th>
<th>SI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch (in)</td>
<td>25.4 mm</td>
</tr>
<tr>
<td>1 foot (ft)</td>
<td>.3048 meter</td>
</tr>
<tr>
<td>1 pound (lb)</td>
<td>.454 kg</td>
</tr>
<tr>
<td>1 pound force (lbf)</td>
<td>4.4482 newtons</td>
</tr>
<tr>
<td>1 foot per minute (fpm)</td>
<td>.005 meters per second</td>
</tr>
<tr>
<td>1 short ton per hour (Q)</td>
<td>907.18 kg per hour</td>
</tr>
</tbody>
</table>

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